A Renormalized Landau Theory of Tricritical Behavior in Polymer Solutions

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The classical Landau theory of tricritical phenomena has been modified to incorporate the effects of critical fluctuations by applying a transformation deduced from the renormalization-group theory. We applied the theory to description of phase separation in solutions of a high molecular-weight polymer in a low molecular-weight solvent. The theory describes a crossover from Ising-like critical behavior asymptotically close to the polymer consolute critical point to tricritical (mean-field like) behavior far away from the consolute critical point. With increase of the molecular weight of a polymer the asymptotic Ising domain shrinks and ultimately vanishes at the *theta* point. Moreover, the critical temperature of the phase separation tends to the *theta* temperature and the critical volume fraction tends to zero. It is known that the *theta* point is a tricritical point for phase separation in polymer solutions at infinite dilution. Systems near the tricritical point obey a special kind of mean-field behavior with logarithmic corrections. We incorporated the logarithmic corrections into our crossover theory phenomenologically by using an effective (renormalized) coupling constant. Based on the theory and on the analysis of experimental data we have developed a universal scaling description of phase separation of polymer solutions in low molecular weight solvents. The critical volume fraction, instead of the commonly used molecular weight, is suggested as a scaling variable. The theory provides an excellent description of experimental data on phase separation for a variety of polymer systems. Recent molecular simulation data have also been described.